Dynamic Frequency Selection (DFS)

Test Report

Product Name	:	HEX Sense
Trade Name	:	Origin Wireless Taiwan Corporation
Model No.	:	Hex Sense
FCC ID	:	2AW26TR-WIFISEN-X

Applicant	:	Origin Wireless Taiwan Corp.
Address	:	3F A1-1 No. 1, Lixing 1st. Rd., Easr Dist. Hsinchu City 300, Taiwan

Date of Receipt	:	Sep. 07, 2020
Issued Date	:	Nov. 19, 2020
Report No.	:	2090185R-E3032610103
Report Version	:	V1.0

Testing Laboratory
3024

DFS Test Report

Issued Date: Nov. 19, 2020
Report No.: 2090185R-E3032610103

Product Name	:	HEX Sense
Applicant	:	Origin Wireless Taiwan Corp.
Address	:	3F A1-1 No. 1, Lixing 1st. Rd., Easr Dist. Hsinchu City 300, Taiwan
Manufacturer	:	WNC VIETNAM CO., LTD.
Model No.	:	Factory H2, Lot G1-3-4-6-8, Que Vo Industrial Park, Van Duong Ward, Bac Ninh City, Bac Ninh Province, Vietnam
FCC ID	:	2AW26TR-WIFISEN-X
EUT Voltage	:	AC 120V/60Hz
Testing Voltage	:	AC 120V/60Hz
Trade Name	:	Origin Wireless Taiwan Corporation
Applicable Standard	:	FCC CFR Title 47 Part 15 Subpart E Section 15.407: 2019 ANSI C63.10: 2013
Laboratory Name	:	Hsin Chu Laboratory
Address	:	No.372-2, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County 31061, Taiwan, R.O.C. TEL: +886-3-582-8001 / FAX: +886-3-582-8958
Test Result	:	Complied

Documented By : Lyla Yang

(Lyla Yang / Engineering Adm. Specialist)

Tested By : Scott Chang

(Scott Chang / Senior Engineer)

Approved By : Louis Hsu

(Louis Hsu / Deputy Manager)

Revision History

Version	Description	Issued Date
V1.0	Initial issue of report.	Nov. 19, 2020

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1. General Information

1.1. EUT Description

Product Name	HEX Sense	
Trade Name	Origin Wireless Taiwan Corporation	
Model No.	Hex Sense	
DFS Frequency Range / Number of DFS Channels	IEEE 802.11a/n (20MHz)	5260~5320MHz / 4 Channels 5500~5700MHz / 11 Channels
	IEEE 802.11n (40MHz)	5270~5310MHz / 2 Channels 5510~5670MHz / 5 Channels
Type of Modulation	802.11a/n	Orthogonal Frequency Division Multiplexing (OFDM)
Data Rate	802.11a	6, 9, 18, 24, 36, 48, 54Mbps
	802.11n	Support a subset of the combination of GI, MCS 0~MCS 7 and bandwidth defined in 802.11n
Channel Control	Auto	
Channel Bandwidth	20/40 MHz	
DFS Function	□Master ■Slave	
TPC Function	■ <500mW not required □ ≧ 500mW employ a TPC*	
Communication Mode	■ IP Based Systems □ Frame Based System □ Other System	
Antenna Gain	Refer to the table “Antenna List”	
HW Version	HW002	
SW Version	0.1.0a	

Antenna Information				
No.	Brand	Model No.	Antenna Type	Antenna Gain
0	WNC	LVX5_3S.00227.111	PIFA Antenna	Bluetooth: 0.44dBi WiFi 5GHz: 3.28 dBi

IEEE 802.11a/n (20MHz)

Working Frequency of Each Channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
52	5260 MHz	56	5280 MHz	60	5300 MHz	64	5320 MHz
100	5500 MHz	104	5520 MHz	108	5540 MHz	112	5560 MHz
116	5580 MHz	120	5600 MHz	124	5620 MHz	128	5640 MHz
132	5660 MHz	136	5680 MHz	140	5700 MHz		

IEEE 802.11n (40MHz)

Working Frequency of Each Channel:							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
54	5270 MHz	62	5310 MHz	102	5510 MHz	110	5550 MHz
118	5590 MHz	126	5630 MHz	134	5670 MHz		

Test Mode	Mode 1: Transmit Mode

Note:

1. This device is a HEX Sense including 5GHz a/n, BT 4.0 transmitting and receiving functions.
2. Regards to the frequency band operation; the lowest、middle and highest frequency of channel were selected to perform the test, and then shown on this report.
3. The EUT description is from the customer declaration.

1.2. Standard Requirement

FCC Part 15.407:

U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30dBm. A TPC mechanism is not required for systems with an E.I.R.P. of less than 500mW.

U-NII devices operating in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems.

1.3. UNII Device Description

(1) The EUT operates in the following DFS band:
1. 5250-5350 MHz
2. 5470-5725 MHz

(2) The U-NII device maximum power is 20.622dBm (E.I.R.P).
Below are the available 50 ohm antenna assemblies and their corresponding gains. 0dBi gain was used to set the -63 dBm threshold level (-64dBm +1 dB) during calibration of the test setup.

(3) WLAN traffic is generated by the test software “Iperf.exe” from the Master device to the Slave device in the transfer data rate >17%.

(4) For the 5250-5350 MHz and 5470-5725 MHz bands, the Master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels using a random algorithm.

1.4. Test Equipment

DFS / SR11-H

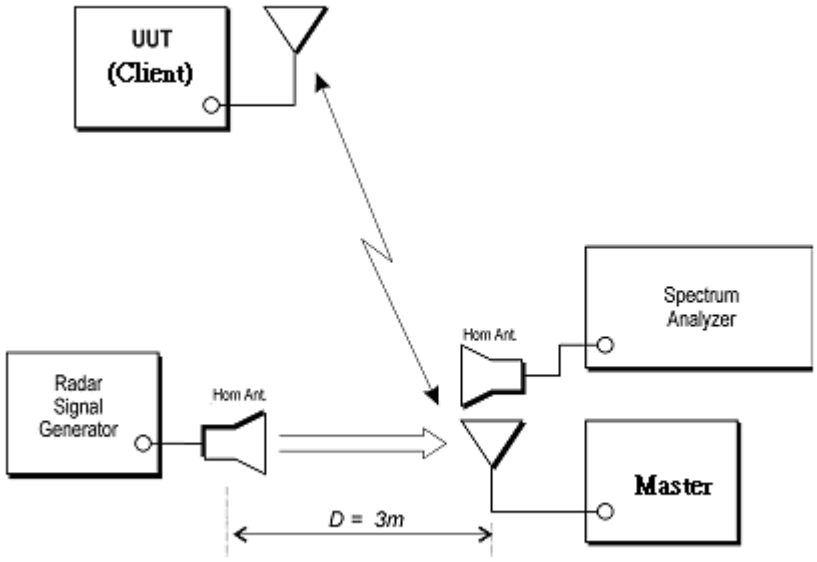
Instrument	Manufacturer	Model No.	Serial No.	Cal. Date	Next Cal. Date
Spectrum Analyzer	Agilent	N9010A	US47140172	2020/06/18	2021/06/17
ESG Vector Signal Generator	Agilent	E4438C	MY45095759	2020/05/11	2021/05/10
MXG Vector Signal Generator	Keysight	N5182B	MY53052548	2020/02/24	2021/02/23
Signal & Spectrum Analyzer	R&S	FSV40	101049	2020/03/30	2021/03/29
EXA Signal Analyzer	Keysight	N9010A	MY51440132	2020/02/21	2021/02/20
Horn Antenna	Schwarzbeck	BBHA 9120D	639	2020/06/04	2021/06/03
Horn Antenna	Schwarzbeck	BBHA 9120D	01656	2020/10/14	2021/10/13
Spectrum Analyzer	Keysight	N9030B	MY57140404	2020/06/03	2021/06/02

Note: All equipment upon which need to calibrated are with calibration period of 1 year.

Instrument	Manufacturer	Type No.	Serial No	FCC ID
Laptop PC	DELL	Vostro A860	CD8BMH1	--
Laptop PC	ASUS	K45VD	0343G3110M	--
Wireless Router	ASUS	ASUS RT-AX88U	JCITHP000040	MSQ-RTAXHP00
ATT (Qty: 3)	Mini-Circuits	BW-S3W2 DC-18GHz	0025	--
RF Cable (Qty: 6)	Schaffner	--	25494/6	--

Software	Manufacturer	Function
Agilent Signal Studio for DFS_V1.0.0	Agilent	Radar Signal Generation Software
Magic iPerf_V1.0	NextDoorDeveloper	iPerf Tool
Device Firmware Version	Arcadyan	200318_1721/ 5.02L.05p1Build09

1.5. Test Setup



1.6. DFS Detection Thresholds

(1) Interference Threshold value, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value (see note)
≥200 milliwatt	-64dBm
EIRP < 200 milliwatt and power spectral density < 10 dBm/MHz	-62dBm
EIRP < 200 milliwatt that do not meet the power spectral density requirement	-64dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. **Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. **Note3:** EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

(2) DFS Response requirement values

Parameter	Value
Non-Occupancy Period	Minimum 30 Minutes
Channel Availability Check Time	60 Seconds
Channel Move Time	10 Seconds See Note 1.
Channel Closing Transmission Time	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period (See Notes 1 and 2)
U-NII Detection Bandwidth	Minimum 100% of the 99% power bandwidth See Note 3.
Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst. Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions. Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.	

2. In-Service Monitoring for Channel Move Time and Channel Closing Transmission Time and Non-Occupancy Period

2.1. Test Procedure

The EUT was tested according to U-NII test procedure of KDB905462 D02 for compliance to FCC 47CFR 15.407 requirements.

These tests define how the following DFS parameters are verified during In-Service Monitoring; Channel Closing Transmission Time, Channel Move Time, and Non-Occupancy Period. The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold + 1dB (-63dBm) is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at 5300MHz/ 5510MHz and 5630MHz.

Stream the MPEG test file from the Master Device to the Client Device on the selected Channel for the entire period of the test.

At time T0 the Radar Waveform generator sends a Burst of pulses for each of the radar types at -63dBm.

Observe the transmissions of the UUT at the end of the radar Burst on the Operating Channel for duration greater than 10 seconds. Measure and record the transmissions from the UUT during the observation time (Channel Move Time). Compare the Channel Move Time and Channel Closing Transmission Time results to the limits defined in the DFS Response requirement values table.

Measure the UUT for more than 30 minutes following the channel close/move time to verify that the UUT does not resume any transmissions on this Channel.

2.2. Test Requirement

Parameter	Value
Channel Move Time	10 Seconds
Channel Closing Transmission Time	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period
Non-Occupancy Period	Minimum 30 minutes

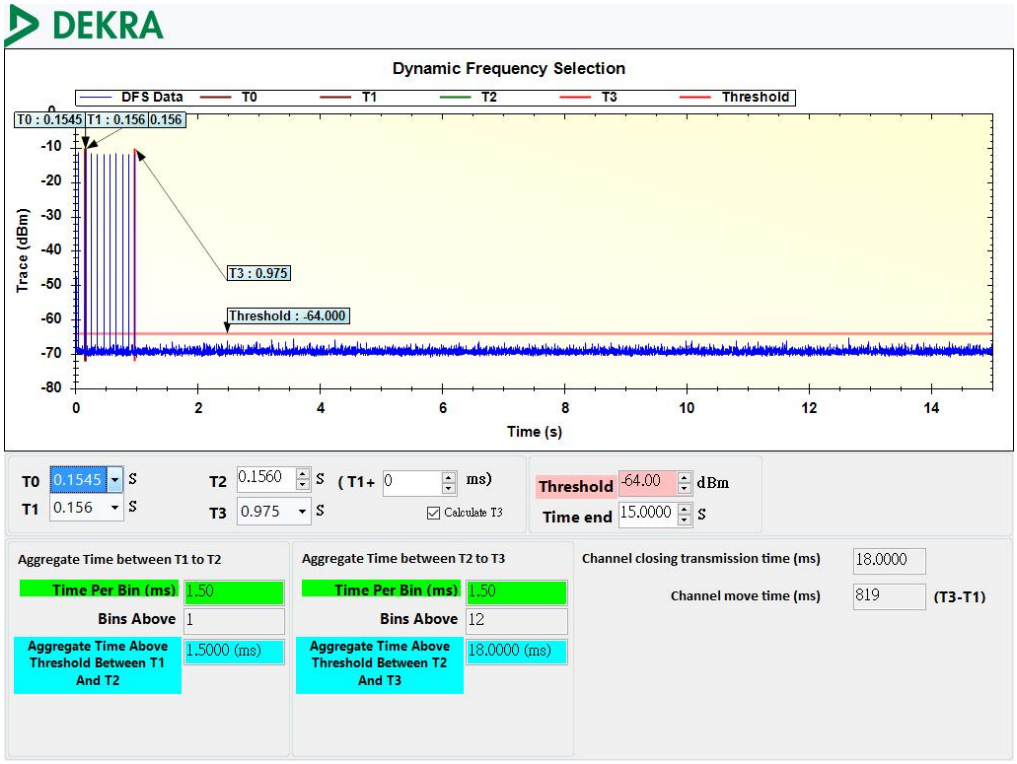
2.3. Uncertainty

± 1ms.

2.4. Test Result of Channel Move Time and Channel Closing Transmission Time and Non-Occupancy Period

Product : HEX Sense
Test Item : Channel Move Time and Channel Closing Transmission Time
Radar Type : Type 0
Test Date : 2020/03/01
Test Mode : Mode 1: Transmit Mode

5300 MHz_20BW



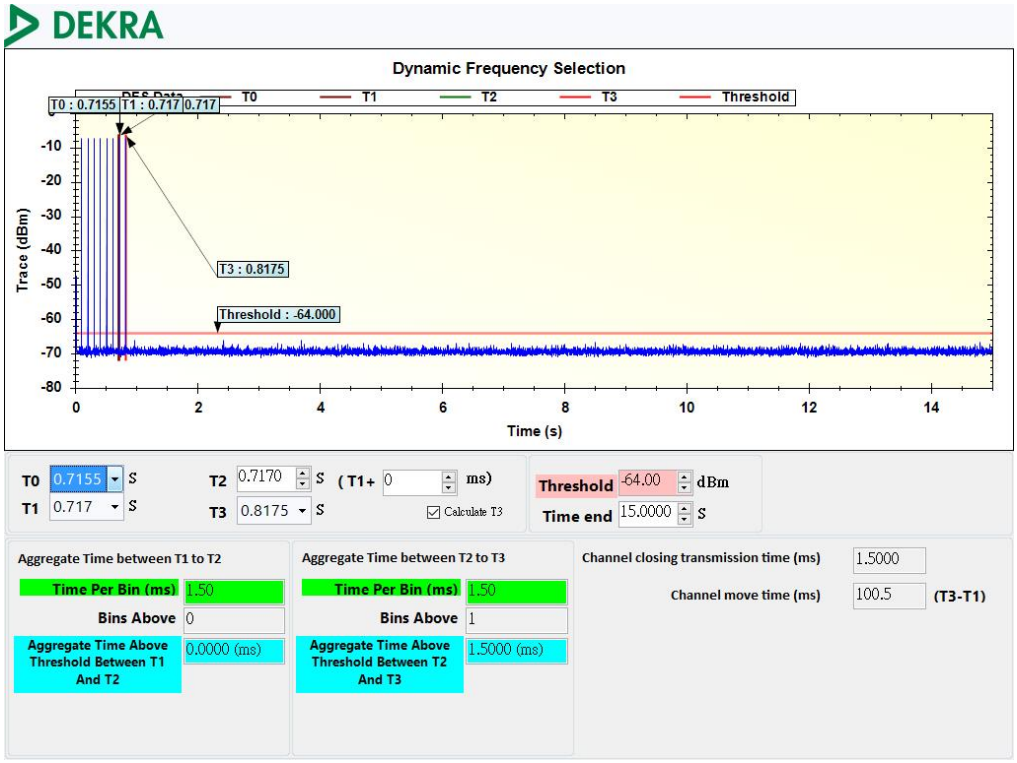
Test Item	Test Result (Sec)	Limit (Sec)
Channel Move Time	0.819	10

The results showed that after radar signal injected the channel move time was less than 10 seconds.

Test Item	Test Result (ms)	Limit (ms)
Channel Closing Transmission	18	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period

The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

5500 MHz_20BW



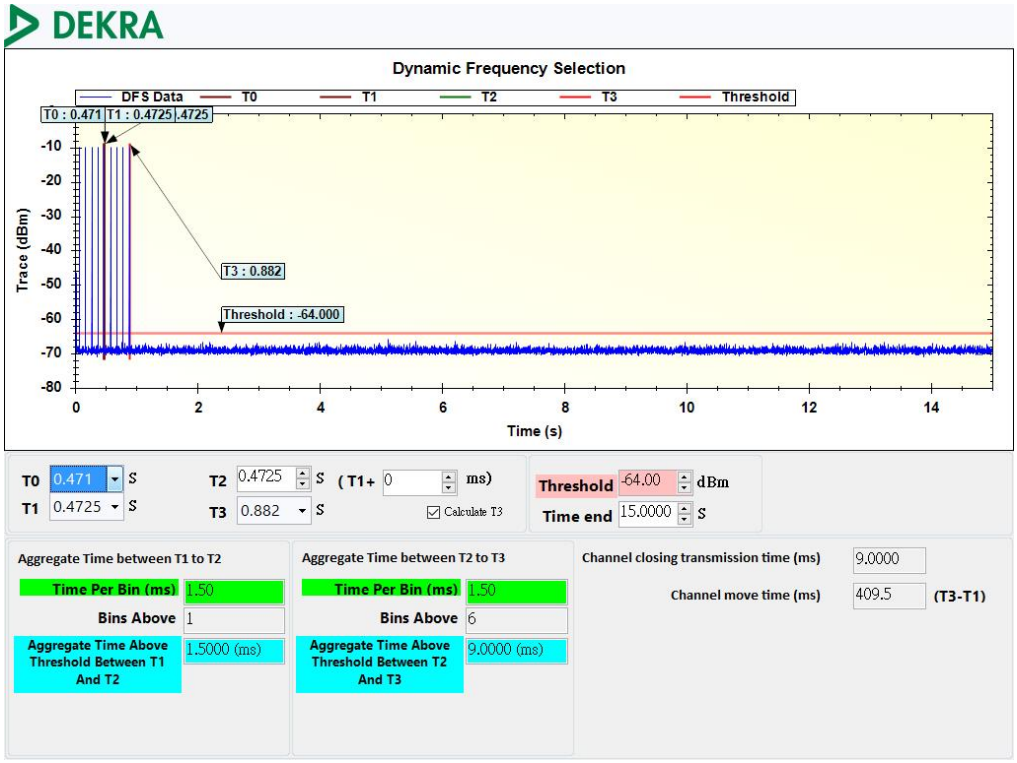
Test Item	Test Result (Sec)	Limit (Sec)
Channel Move Time	0.101	10

The results showed that after radar signal injected the channel move time was less than 10 seconds.

Test Item	Test Result (ms)	Limit (ms)
Channel Closing Transmission	1.5	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period

The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

5620 MHz_20BW



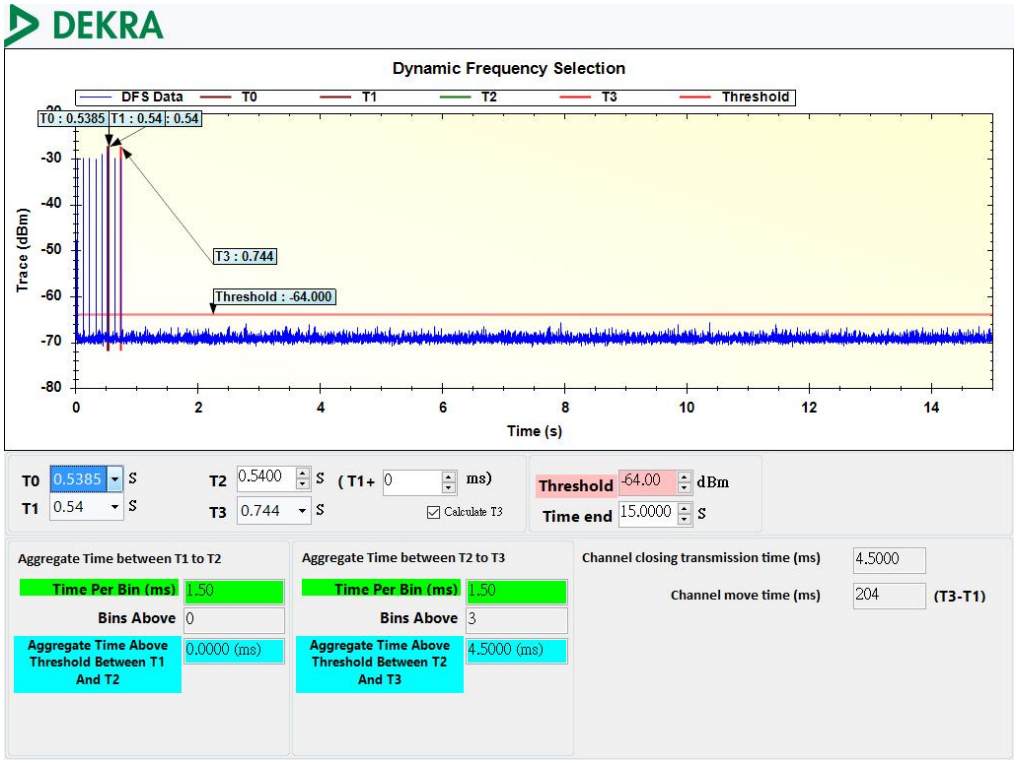
Test Item	Test Result (Sec)	Limit (Sec)
Channel Move Time	0.410	10

The results showed that after radar signal injected the channel move time was less than 10 seconds.

Test Item	Test Result (ms)	Limit (ms)
Channel Closing Transmission	9	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period

The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

5270 MHz_40BW



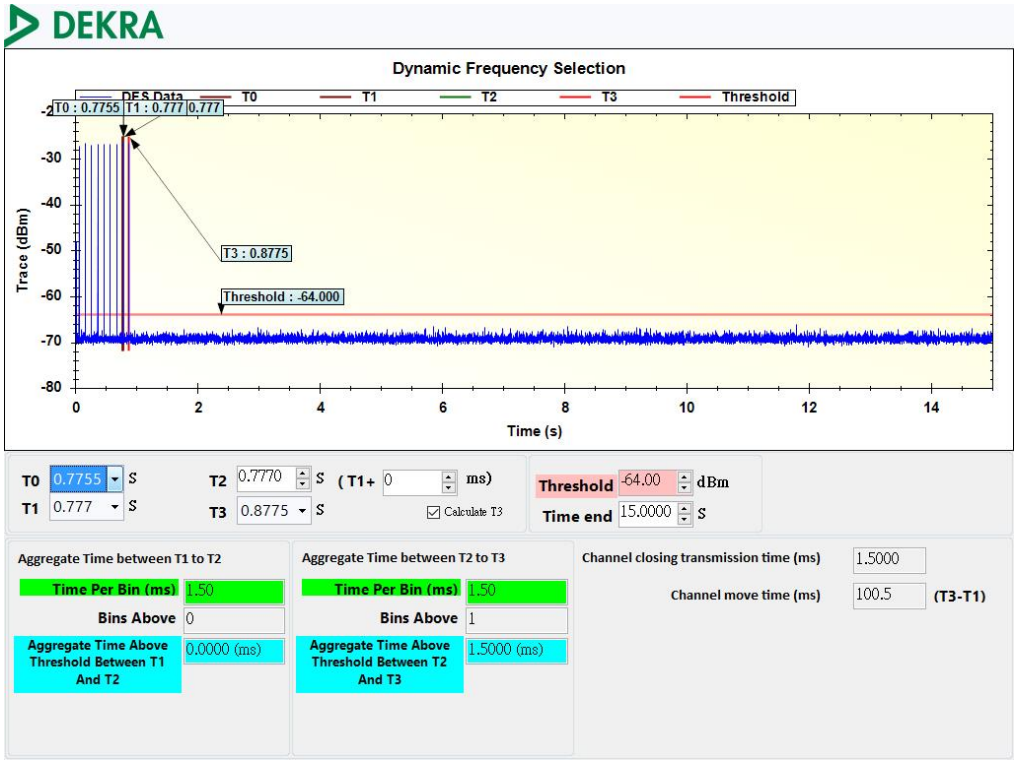
Test Item	Test Result (Sec)	Limit (Sec)
Channel Move Time	0.204	10

The results showed that after radar signal injected the channel move time was less than 10 seconds.

Test Item	Test Result (ms)	Limit (ms)
Channel Closing Transmission	4.5	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period

The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

5550 MHz_40BW



Test Item	Test Result (Sec)	Limit (Sec)
Channel Move Time	0.101	10

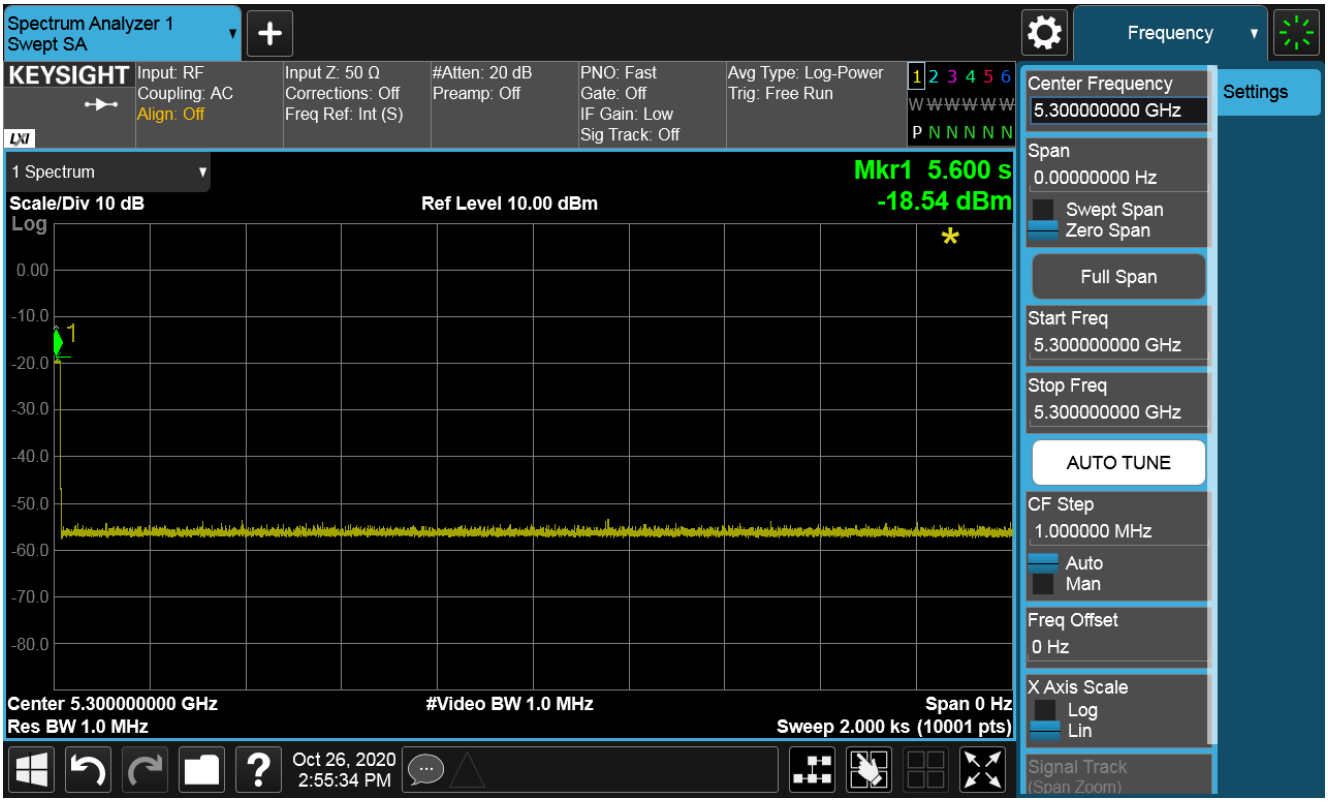
The results showed that after radar signal injected the channel move time was less than 10 seconds.

Test Item	Test Result (ms)	Limit (ms)
Channel Closing Transmission	1.5	200 milliseconds + approx. 60 milliseconds over remaining 10 seconds period

The results showed that after radar signal injected the channel transmission closing time less than 200 milliseconds and an aggregate of no more than 60 milliseconds.

Product : HEX Sense
Test Item : Non-Occupancy Period
Radar Type : Type 0
Test Date : 2020/10/26
Test Mode : Mode 1: Transmit Mode

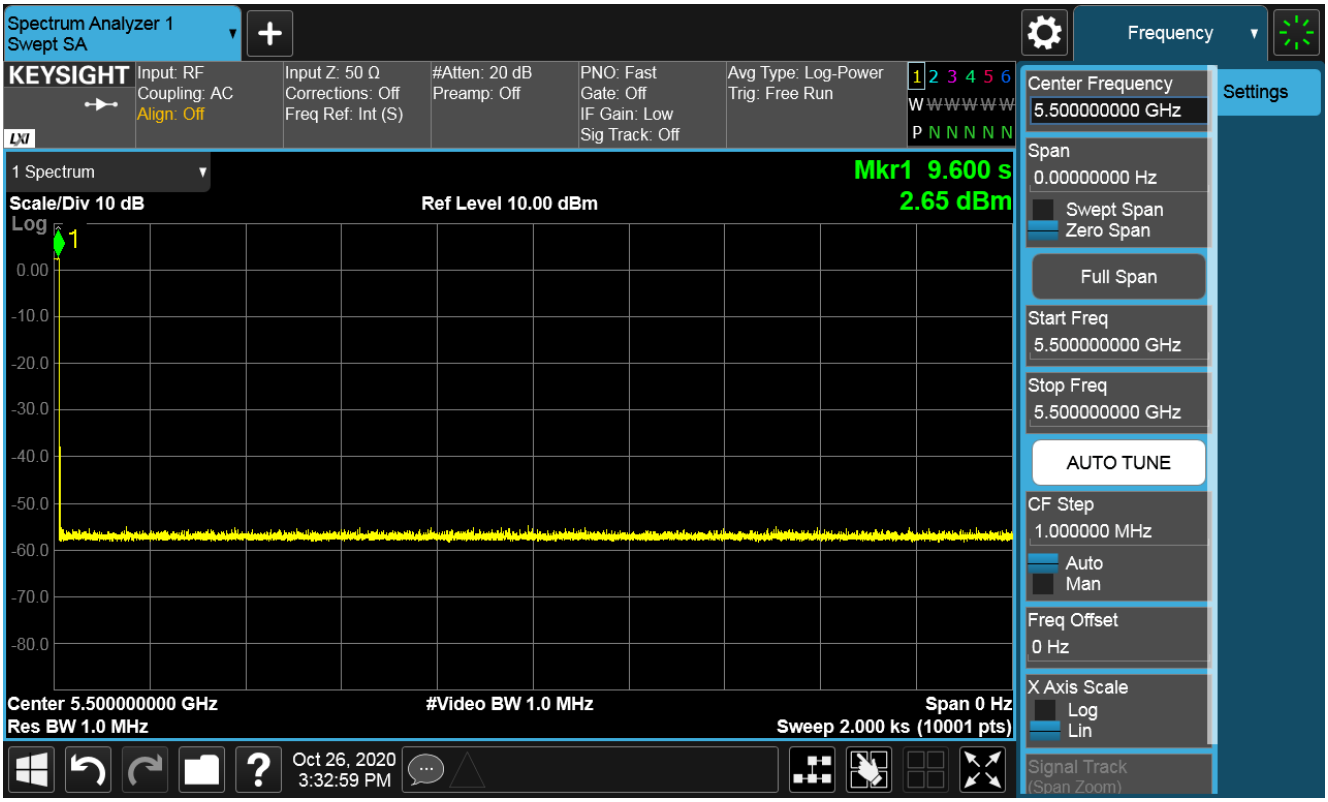
5300 MHz_20BW



Test Item	Test Result (Minutes)	Limit (Minutes)
Non-Occupancy Period	>30	>30

*No EUT transmissions were observed on the test channel during 30 minutes observation time.

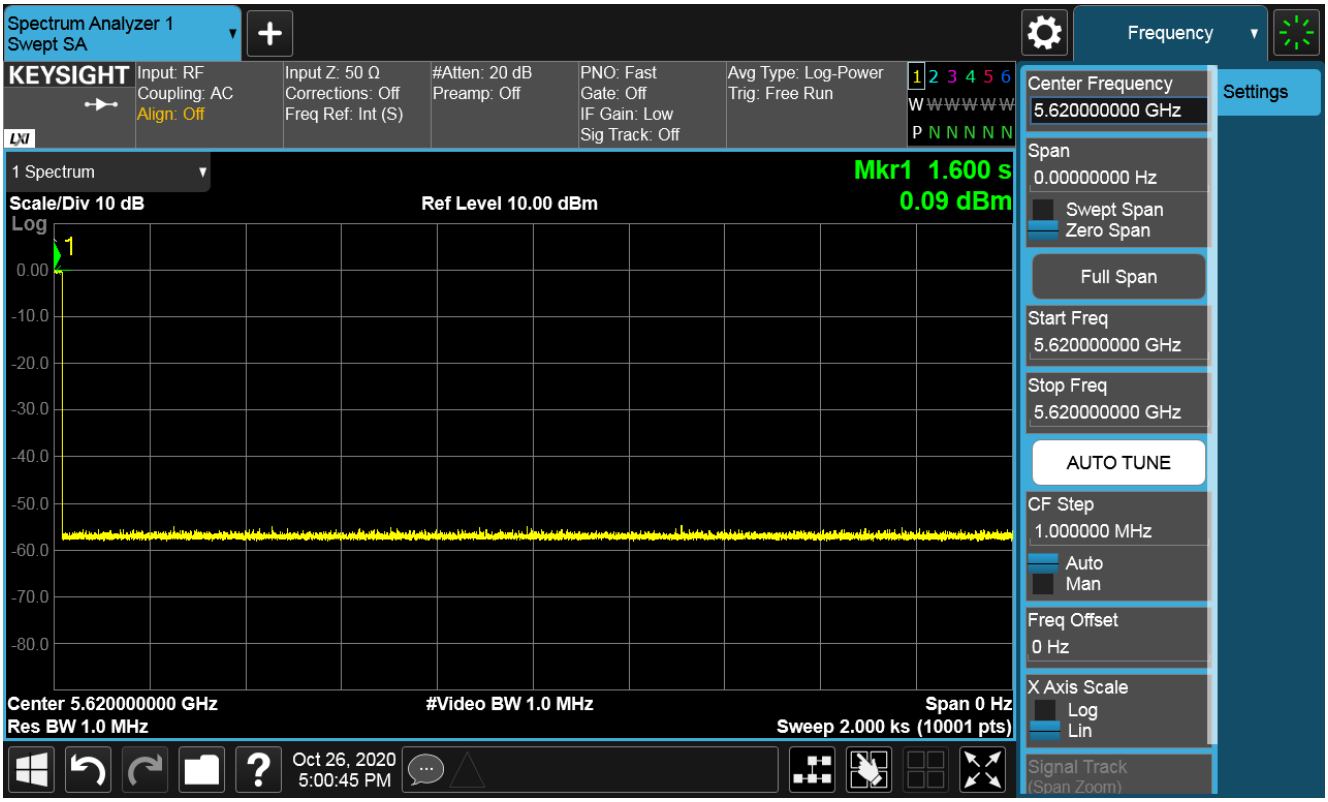
5500 MHz_20BW



Test Item	Test Result (Minutes)	Limit (Minutes)
Non-Occupancy Period	>30	>30

*No EUT transmissions were observed on the test channel during 30 minutes observation time.

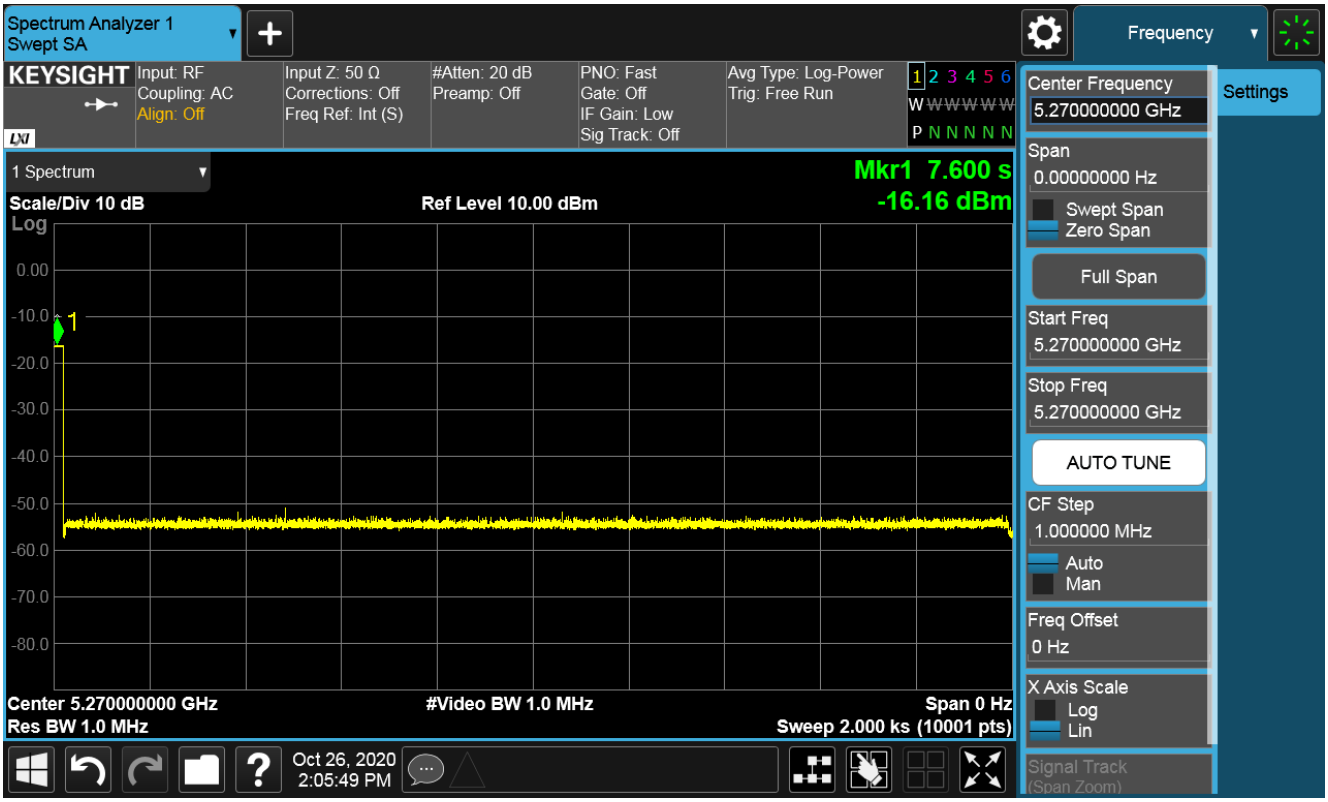
5620 MHz_20BW



Test Item	Test Result (Minutes)	Limit (Minutes)
Non-Occupancy Period	>30	>30

*No EUT transmissions were observed on the test channel during 30 minutes observation time.

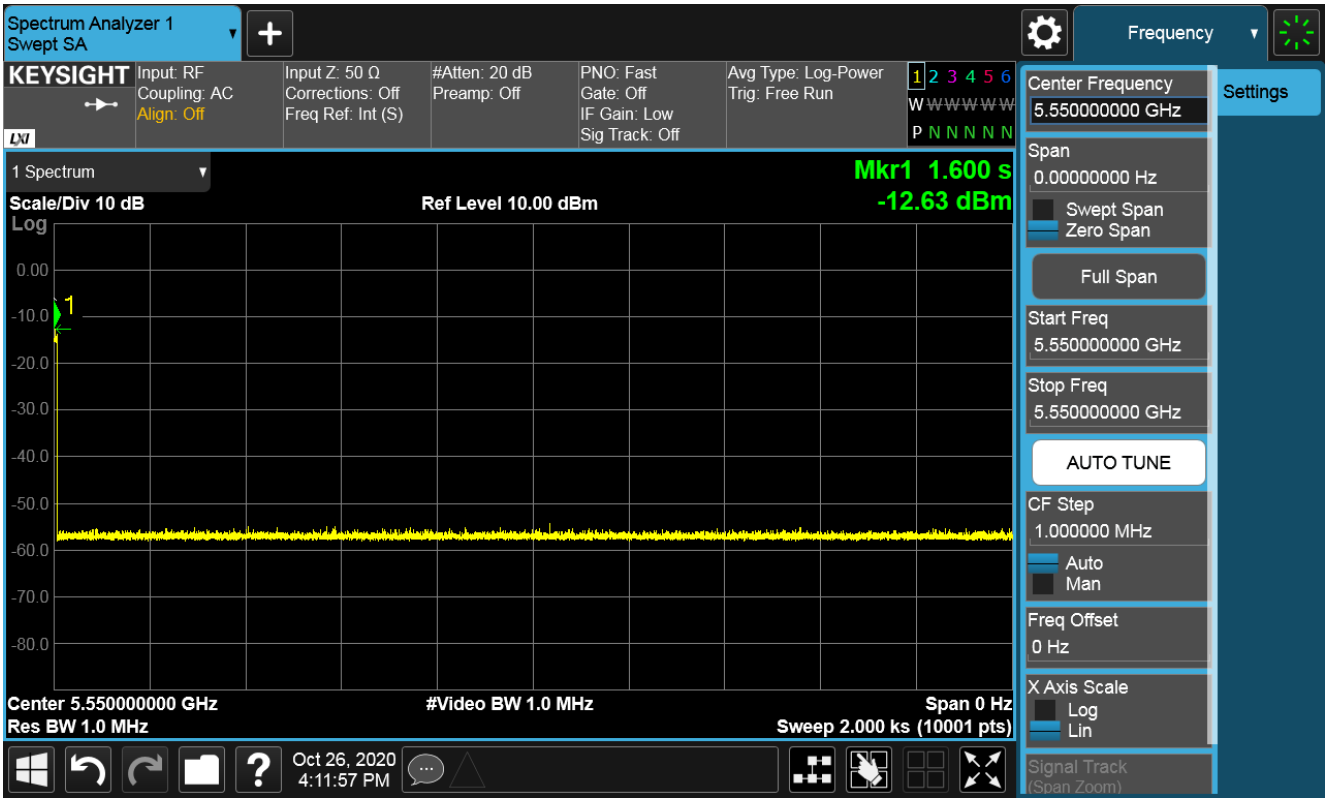
5270 MHz_40BW



Test Item	Test Result (Minutes)	Limit (Minutes)
Non-Occupancy Period	>30	>30

*No EUT transmissions were observed on the test channel during 30 minutes observation time.

5550 MHz_40BW



Test Item	Test Result (Minutes)	Limit (Minutes)
Non-Occupancy Period	>30	>30

*No EUT transmissions were observed on the test channel during 30 minutes observation time.